at the hands of experienced systematists. The concluding chapter, dealing with the bearing of palæobotanical evidence on plant evolution, is full of interest, and particularly valuable as being written by one who possesses both a wide knowledge of the available data and the power of critically weighing the evidence. Referring to the comparative study of species of fossil plants, Zeiller writes:

"Les Espèces, commes les genres, se succèdent par voie de substitution et non par voie de transformation graduelle, et il en parait être de même à tous les niveaux."

A very useful bibliography of writings referred to in the text is given at the end of the volume. A. C. S.

PHOTOGRAPHY IN NATURAL COLOURS.

Lehrbuch der Photochromie (*Photographie der natürlichen Farben*). Von Wilhelm Zenker; neu herausgegeben von Prof. Dr. B. Schwalbe. Pp. xiii + 157. (Braunschweig: Vieweg und Sohn, 1900)

IN 1868, after long study and repetitions of Edmond Becquerel's experiments on photochromy, Dr. Wilhelm Zenker himself printed and published a "Lehrbuch der Photochromie," which contained a physical explanation of the colour-correctness of these photochromatic images. Zenker's book did not have a wide circulation—it would be difficult, perhaps, to name any one in England who has read it—and it was not until 1890 that Lippmann, by founding a *new* method on the principle suggested by Zenker, drew a slightly increased attention to Zenker's labours. That the attention was only slightly increased was due to two causes: firstly, the rather astonishing *results* of Lippmann and others helped to overshadow the *principle* of Zenker in the eyes of most people; secondly, among all those whose pursuits have any claim to be considered as scientific, English photographers are especially noticeable for their deliberate ignorance of the creative work of the past in photography.

For the latter reason, chiefly, the present writer has given, during the past year, a rather full analysis of Zenker's work in "Camera Obscura," and we have now a reprint, in good *English* type, of the book. In the words of the preface, "The more modern researches on photography in natural colours have shown that the way and the explanations of modern attempts are connected in many respects with Zenker's ideas." The volume contains besides a portrait of Zenker, a sketch of his life and index of his works by Prof. Gustav Krech; and, finally, Herr E. Tonn gives (pp 131–157) an account of the further development of photochromy on the foundations of Zenker's theory. We shall notice these briefly in their order; but, with regard to the "Lehrbuch" itself, shall abstain from entering at all fully into the subject of its contents, as in the above-cited reference there is already a full account of it in English.

Wilhelm Zenker (1829–1899) cultivated many different branches of knowledge. His first papers (1850–1866) were zoological; the "Lehrbuch" was his first contribution to photography; and his other papers were on colour-perception (1867), photography and physical optics, astrophysics, and, in later life, meteorology. The "Lehrbuch," however, is probably the most important of his works, and it is to be hoped that now, with this excellent reprint, his methods will have some influence on English photography.[1]

The book is divided into three parts: (1) Considerations on colours ("Das Wesen der Farben"); (2) Account of his predecessors' work in photochromy ("Die Wiedergabe der Farben"); and the third part ("Theorie der Photochromie"), after an account of the theories of Seebeck, Becquerel and others, contains Zenker's own ideas (pp. 116–129). There are one or two useful notes to this section.

Herr Tonn's section, with one exception, seems very complete, and full references are given. It is, however, a pity that the very pregnant hint of Lord Rayleigh should be unnoticed (*Phil. Mag.*, 1887). Lord Rayleigh, independently of Zenker, and starting from totally different considerations, indicated in a footnote the Zenker principle, and even went farther; for not only did he seek to *explain* the results of Becquerel by this principle, but seemed to see the possibility of a *new* method of photochromy based on it. It would be interesting to have some account of Lord Rayleigh's then promised experimental investigations. If Herr Tonn knew this paper, it is difficult to understand how he resisted the temptation of comparing Rayleigh and Zenker—Zenker who was so clearly a non-mathematician.

The chief value of the book, the writer persists in believing, is not historical—for it *has* not had very much influence in the moulding of thought—but is in its spirit; the influence of its point of view and methods is needed above all at the present time for English photographers; this does not mean, of course, the small number of English *photo-chemists*.

PHILIP E. B. JOURDAIN.

OUR BOOK SHELF.

Die Harze und die Harzbehälter. By A. Tschirch. Pp. viii + 417. (Leipzig: Gebrüder Borntraeger, 1900.)

THE author has spent eight years in collecting and arranging the scattered facts relating to the obscure group of organic compounds which are classified as resins by virtue of a common physical characteristic.

What Kekulé termed "the chemical lumber room" contained at one time a collection of similar obscure groups, such as the alcaloids, colouring matters, tannins, aromatic compounds, &c.; but since the year when that chemist gave to the world his benzene formula, the lumber room has been industriously ransacked and its contents dragged forth into the light of day. Perhaps the resins have received the scantiest share of attention; partly, no doubt, owing to the practical difficulties which they offer to the chemist.

We know nothing of the molecular state which finds its physical expression in these amorphous, translucent compounds, nor how to bring them into a condition of ascertained purity. How often does a promising research miscarry by the unwelcome appearance of resinous products! Nevertheless the mass of research which has accumulated on the subject fills 400 closely printed pages.

A great amount of this research gives very little indication of the nature of the resins themselves. The older chemists distilled them and obtained products such

[1] His work for the Paris Academy prize in 1868 stands in close relation to his theory of photochromy (see Fizeau's report, *Compt. rend.*, lxvi., lxvii.). Zenker's memoir was never published, and Otto Wiener (*Wied. Ann.*, 1890, 1895) later and independently followed the same train of thought. (*Cf.* also Cornu, Poincaré, Potier and Berthelot, *Compt. rend.*, cxii.; and Drude, *Wied. Ann.*, xli., xliii.).

as benzoic acid, toluene, turpentine, &c. At a later date this severe method of treatment was replaced by the milder action of fused potash, with the result that a number of new aromatic acids and phenols were discovered. At the present time the separation of the various constituents of a resin is effected by the use of solvents and the numerous reagents which the resources of modern organic chemistry can offer. The results do not carry us very far. As the author says, "our march of conquest has only begun, and the present volume may suggest a successful plan of campaign." J. B. C.

The Lepidoptera of the British Islands: a Descriptive Account of the Families, Genera and Species Indigenous to Great Britain and Ireland, their Preparatory States, Habits and Localities. By Charles G. Barrett, F.E.S. Vol. vi. Parts 59-70. Heterocera (Noctuina—Geometrina). Pp. 388. Plates 233-280. (London: Lovell, Reeve and Co., Ltd., 1900.)

THE present instalment of Mr. Barrett's great work includes 110 species, from *Hoporina croceago*, Schiff., to *Halix wauaria*, L., and is written in the same exhaustive manner as previous volumes, giving all the information that a collector of British Lepidoptera (as such) is most likely to require. To Continental entomologists who wish to acquire an accurate knowledge of our limited insular fauna it would also prove very useful; though it is to be regretted that the bulk of the book, which may be expected to extend to nearly twenty volumes, and the unavoidable costliness of the larger edition issued with plates (which are not included in the cheap edition), must necessarily tend to restrict the sale. Those requiring it may therefore be recommended to obtain it volume by volume, or in monthly parts, as it appears, rather than to wait till the whole work is completed. We need not repeat our comments on earlier volumes, which will equally apply to the one before us; but the accounts given of the habits of the various moths discussed are always interesting, and sometimes curious; thus we learn that the rare *Cerastis erythrocephala*, Schiff., after its discovery in 1847, was met with occasionally till 1859, when it seems to have almost disappeared till 1872 and 1873, since when only one specimen, taken in 1894, has been found in England. The periodicity of the appearance of many species in these islands is curious, and has never been fully explained, for the causes which appear applicable to some cases will not explain others; and, moreover, uncertainty in the appearance of species seems to increase rather than to diminish. English names are not a conspicuous feature in this book, but Mr. Barrett notes that a recent writer has called *Xylina conformis*, Schiff., "The Conformist," and the next species, *X. lambda*, Fab., "The Nonconformist"! The resemblance of species of *Calocampa* and *Cucullia* to bits of stick is commented on; in fact, certain moths and larvæ thus fill the gap in our protected fauna caused by the absence of the stick insects proper, or Phasmidæ, which are not found nearer to our shores than the South of France. Several species noted in this volume seem to be now extinct in our islands; thus, *Chariclea delphinii*, L., does not seem to have been taken in England since about 1815. Their place has been taken by others; for example, the northern migration of *Plusia moneta*, Fab., reached England in 1890, and is probably still extending. Other moths of interest are those with cannibal larvæ, such as *Scopelosoma satellitia*, L., *Heliothis armigera*, Hübn., &c. There are many other interesting observations, which we have no room to quote, in the present volume, comprising, as it does, the conclusion of the Noctuæ, the Deltoidæ, and the first few species of the Geometræ. We may, however, note that the enigmatical *Sarrothripa revayana*, Schiff., is regarded by Mr. Barrett as a true *Noctua*, and is placed at the end of the *Noctuae Trifidae*.

W. F. K.

LETTER TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Plankton of the Bay of Biscay.

WITH the valuable assistance of Mr. L. A. Borradaile, of Selwyn College, Cambridge, I have just completed a series of observations on the plankton of the Bay of Biscay, extending over about three weeks, by means of opening and closing nets as well as ordinary tow-nets. Our observations point to the fact (unexpected at any rate by myself) that the smaller Mesoplankton practically ceases at a depth of about 1000 fathoms. This conclusion agrees with that reached by Prof. Chun on the basis of the *Valdivia* Expedition (Deutsche Tiefsee Expedition, 1898-99, p. 44), with which, however, we were unacquainted until we had arrived at it independently. Below this limit we almost always captured a few specimens, as to which it was doubtful whether they were alive when captured, or were merely corpses of a shallower fauna sinking to the bottom, but in a few cases we at present incline to assign them to a living Mesoplankton.

We have also taken about 90 hauls under varied conditions at varied depths between 100 fathoms and the surface, which will eventually, we hope, give a fairly accurate basis for the determination of the vertical movements of the Epiplankton.

Our thanks are due to the Lords Commissioners of the Admiralty for placing the ship at our disposal, and to Captain Field and the other officers of the *Research* for their ungrudging assistance. G. HERBERT FOWLER.

H.M.S. *Research*, Devonport, July 27.

THE TEACHING OF MATHEMATICS.

I THINK it very important to try to get a view of our system of teaching mathematics which is not too much tinted with the pleasant memories of one's youth. Like all the men who arrogate to themselves the right to preach on this subject, I was in my youth a keen geometrician, loving Euclid and abstract reasoning. But I have taught mathematics to the average boy at a public school, and this has enabled me to get a new view. I have seen faces bright outside my room become covered as with a thin film of dulness as they entered; I have known men, the best of their year in England in classics, lose in half an hour (as men did in the first day of slavery in old times) half their feeling of manhood; and I have known that, as an orthodox teacher of mathematics, I was really doing my best to destroy young souls. Happily, our English boys instinctively take to athletics as a remedy, and I know of nothing which gives greater proof of the inherent strength, in good instincts and common sense, of our race than this refusal to allow one's soul to be utterly destroyed. I have also mixed much with engineers, who really need some mathematics in their daily work, men who say that they once were taught mathematics, and I know that these men never use anything more advanced than arithmetic, and actually loathe a mathematical expression when it intrudes itself into a paper read before an engineering society. Of all branches of engineering, electrical engineering relies most upon exact calculation. Well, the average electrical engineer in good practice would rather work a week at many separate arithmetical examples than try for an hour to get out the simple algebraic expression, which includes all his week's results and much more. Yet he has passed perhaps certain rather advanced examinations in mathematics. Furthermore, those engineers who can most readily apply mathematics to engineering problems, almost invariably descend to the position of teachers and professors in schools and colleges, and they seem to lose touch completely with the actual life of their profession.